

What is claimed is:

1. A solenoid valve comprising:

a slider, which is axially reciprocable;

a spring, which provides urging force for urging the slider in a first axial direction of the solenoid valve;

a coil, which generates magnetomotive force for attracting the slider in a second axial direction opposite to the first axial direction;

a first stator segment including:

an attracting portion, which is axially opposed to the slider and attracts the slider in the second axial direction upon generation of the magnetomotive force by the coil; and

a boss portion, which axially protrudes from an outer peripheral side of the attracting portion toward the slider, wherein the boss portion includes a tapered outer peripheral surface and a tapered inner peripheral surface;

a second stator segment, which forms a magnetic circuit in cooperation with the slider and the first stator segment and includes a tubular portion, wherein the tubular portion is axially spaced from the boss portion and is at least partially placed radially outward of the slider; and

a non-magnetic body, which is at least partially placed radially inward of the tubular portion of the second stator segment to slidably support the slider therein.

2. A solenoid valve according to claim 1, wherein:

the tapered outer peripheral surface of the boss portion is tapered at a predetermined taper angle ranging from 11 to 18 degrees defined between the tapered outer peripheral surface and a first imaginary axial line, which extends parallel to a central axis of the first stator segment from a base end of the tapered outer peripheral surface; and

the tapered inner peripheral surface of the boss portion is tapered at a predetermined taper angle ranging from 1 to 8 degrees defined between the tapered inner peripheral surface and a second imaginary axial line, which extends parallel to the central axis of the first stator segment from a base end of the tapered inner peripheral surface.

3. A solenoid valve according to claim 2, wherein the predetermined taper angle of the tapered outer peripheral surface of the boss portion is about 16 degrees, and the predetermined taper angle of the tapered inner peripheral surface of the boss portion is about 3 degrees.

4. A solenoid valve according to claim 1, wherein an axial end of the slider, which is opposed to the attracting portion of the first stator segment, has substantially no taper.

5. A solenoid valve according to claim 1, wherein the solenoid valve is a solenoid-operated oil pressure control valve, which selectively supplies and drains oil pressure of an oil pressure source relative to a retarding oil pressure chamber and an

advancing oil pressure chamber of an intake/exhaust variable valve timing mechanism that changes opening timing and closing timing of at least one of an intake valve and an exhaust valve of an internal combustion engine.

6. A solenoid valve according to claim 1, wherein the tapered outer peripheral surface of the boss portion and the tapered inner peripheral surface of the boss portion merge with each other.

7. A solenoid valve comprising:

a slider, which is axially reciprocable and includes a communication passage that extends through the slider generally along a central axis of the slider, wherein the communication passage is communicated with at least one first side space located on first axial side of the slider and is also communicated with at least one second side space located on second axial side of the slider;

a spring, which provides urging force for urging the slider in a first axial direction of the solenoid valve;

a coil, which generates magnetomotive force for attracting the slider in a second axial direction opposite to the first axial direction;

a first stator segment, which includes an attracting portion, wherein the attracting portion is axially opposed to the slider and attracts the slider in the second axial direction upon generation of the magnetomotive force by the coil;

a second stator segment, which forms a magnetic circuit in cooperation with the slider and the first stator segment and includes a tubular portion, wherein the tubular portion is at least partially placed radially outward of the slider; and

a non-magnetic body, which is at least partially placed radially inward of the tubular portion of the second stator segment to slidably support the slider therein.

8. A solenoid valve according to claim 7, further comprising:

a valve member, which is arranged in an axially reciprocable manner and is urged against the slider by the urging force of the spring such that the valve member moves together with the slider, wherein the valve member defines at least one connecting passage, which communicates between the communication passage of the slider and the at least one second side space; and

a valve housing, which receives the valve member.

9. A solenoid valve according to claim 8, wherein:

the at least one first side space includes a first reciprocation space of the slider, which is located adjacent to a first axial end of the slider and allows axial movement of the slider in the first axial direction; and

the at least one second side space includes a second reciprocation space of the slider, which is located adjacent to a second axial end of the slider and allows axial movement of the slider in the second axial direction.

10. A solenoid valve according to claim 9, wherein:

the at least one connecting passage defined by the valve member includes an end groove, which is formed in one end of the valve member in opposed relationship to the communication passage of the slider; and

the end groove of the valve member extends diametrically through the one end of the valve member and communicates between the communication passage of the slider and the second reciprocation space of the slider.

11. A solenoid valve according to claim 9, wherein:

the valve member includes a large diameter cylindrical portion and a small diameter cylindrical portion, wherein the small diameter cylindrical portion abuts against the slider; and

the at least one second side space includes at least one of first and second reciprocation spaces of the large diameter cylindrical portion, which are arranged adjacent to first and second axial ends of the large diameter cylindrical portion, respectively, to allow reciprocation of the valve member.

12. A solenoid valve according to claim 11, wherein:

the first stator segment includes an axial through hole, which axially penetrates through the first stator segment and receives the small diameter cylindrical portion of the valve member, wherein an outer peripheral surface of the small diameter cylindrical portion of the valve member defines an outer

peripheral connecting passage in cooperation with an inner peripheral surface of the first stator segment;

the outer peripheral connecting passage of the small diameter cylindrical portion of the valve member is communicated with the second reciprocation space of the slider and also with the first reciprocation space of the large diameter cylindrical portion of the valve member; and

the at least one connecting passage defined by the valve member includes the outer peripheral connecting passage of the small diameter cylindrical portion of the valve member.

13. A solenoid valve according to claim 12, wherein:

the large diameter cylindrical portion of the valve member includes:

a first drain passage, which extends in an axial direction of the large diameter cylindrical portion and penetrates through the second axial end of the large diameter cylindrical portion such that the first drain passage is communicated with the second reciprocation space of the large diameter cylindrical portion; and

a second drain passage, which penetrates through a wall of the large diameter cylindrical portion and is communicated with the first drain passage of the large diameter cylindrical portion and also with the first reciprocation space of the large diameter cylindrical portion; and

the at least one connecting passage defined by the valve member includes the first drain passage and the second drain

passage of the large diameter cylindrical portion.

14. A solenoid valve according to claim 13, wherein:

the valve housing includes a drain port for draining a working fluid from the solenoid valve; and

the drain port of the valve housing is communicated with at least one of the first and second reciprocation spaces of the large diameter cylindrical portion of the valve member.

15. A solenoid valve according to claim 8, wherein:

the valve member includes a large diameter cylindrical portion and a small diameter cylindrical portion, wherein the small diameter cylindrical portion abuts against the slider;

the at least one second side space includes at least one of first and second reciprocation spaces of the large diameter cylindrical portion, which are arranged adjacent to first and second axial ends of the large diameter cylindrical portion, respectively, to allow reciprocation of the valve member;

the small diameter cylindrical portion includes an axial connecting passage, which extends through the small diameter cylindrical portion in an axial direction of the small diameter cylindrical portion and is communicated with the communication passage of the slider;

the large diameter cylindrical portion includes:

a first drain passage, which extends in an axial direction of the large diameter cylindrical portion and is communicated with the axial connecting passage of the small

diameter cylindrical portion, wherein the first drain passage penetrates through the second axial end of the large diameter cylindrical portion such that the first drain passage is communicated with the second reciprocation space of the large diameter cylindrical portion; and

a second drain passage, which penetrates through a wall of the large diameter cylindrical portion and is communicated with the first drain passage of the large diameter cylindrical portion and also with the first reciprocation space of the large diameter cylindrical portion; and

the at least one connecting passage defined by the valve member includes the axial connecting passage of the small diameter cylindrical portion, the first drain passage of the large diameter cylindrical portion and the second drain passage of the large diameter cylindrical portion.

16. A solenoid valve according to claim 15, wherein:

the valve member is made of a magnetic material;

the slider is made of a magnetic material; and

one end of the small diameter cylindrical portion, which abuts against the slider, includes a tubular portion, which is made of a non-magnetic material.

17. A solenoid valve according to claim 15, wherein:

the valve housing includes a drain port for draining a working fluid from the solenoid valve; and

the drain port of the valve housing is communicated with



at least one of the first and second reciprocation spaces of the large diameter cylindrical portion of the valve member.

18. A solenoid valve according to claim 7, wherein the first stator segment includes a boss portion, which axially protrudes from an outer peripheral side of the attracting portion toward the slider, wherein the boss portion includes a tapered outer peripheral surface and a tapered inner peripheral surface.